

Observations of the Solar Eclipse of 1870, Dec. 21–22, made at the Royal Observatory, Greenwich.

(Communicated by the Astronomer Royal.)

As this eclipse afforded a very favourable opportunity of determining the error of Hansen's Lunar Tables at the period of conjunction, a plan of observations, similar to that arranged for the eclipse of 1860, was prepared by the Astronomer Royal, and carried out as far as the weather permitted.

With the Great Equatoreal four quantities were to be determined, viz. :—

$$\begin{array}{llll}
 da = & \text{Correction to excess of Moon's R.A.} & \text{over Sun's R.A.} & \\
 d\delta - d\Delta = & \text{,,} & \text{,,} & \text{N.P.D.} \quad \text{,,} \quad \text{N.P.D.} \\
 dS = & \text{,,} & \text{Sun's Semidiameter} & \\
 ds = & \text{,,} & \text{Moon's} & \text{,,}
 \end{array}$$

for which the following arrangement of observations was made:—

- (1) A series of differences of N.P.D. of the Upper and Lower Cusps, showing principally the effect of the correction,

$$ds + dS + da.$$

- (2) A series of differences of times of transit of Moon's 2 L. and Sun's 2 L., giving

$$ds - dS + da.$$

- (3) A series of differences of N.P.D. of Moon's N.L. and Sun's N.L., giving

$$-ds + dS + (d\delta - d\Delta).$$

- (4) A series of differences of N.P.D. of the Right and Left Cusps, giving chiefly the effect of da .

- (5) The same as series (3).

- (6) A series of differences of times of transit of Sun's 1 L. and Moon's 1 L., giving

$$-ds + dS + da.$$

- (7) A series of differences of N.P.D. of the Upper and Lower Cusps, giving

$$ds + dS - da.$$

The first set having been lost through cloud, the remainder furnished five resulting equations, formed by taking the sums of the equations, corresponding to each series of observations, obtained by a comparison of the measured with the tabular quantity as affected by the symbolical corrections given above. These being treated by the method of least squares gave four equations, of which the following is the solution :—

$$\begin{aligned} da &= -6''.47 \\ d\delta - d\Delta &= +1''.21 \\ dS &= -1''.68 \\ ds &= -0''.49 \end{aligned}$$

From meridian observations on Dec. 20, 23, 24, 28, 29, the Sun's tabular error was found:—

$$\begin{aligned} \text{In R.A.} &= +0''.11 \\ \text{In N.P.D.} &= +2''.2 \end{aligned}$$

Combining this result with that given above, we obtain as the tabular error of the Moon:—

$$\begin{aligned} \text{In R.A.} &= +0''.54 \\ \text{In N.P.D.} &= +1''.0 \end{aligned}$$

The effect of these corrections on the choice of stations for observing the totality appears to be very small. The central line would be shifted nearly 5 miles further south, and the breadth of the shadow increased by about double that amount, whilst the time of first contact would be accelerated and of last contact retarded by about 10^s.

The altazimuth observations give error of tabular altazimuth:—

$$\begin{aligned} \text{Of Moon's 2 L.} &= -11''.00 \text{ from 6 Obs.} \\ \text{,, 1 L.} &= -3''.83 \text{ ,, 12 ,,} \end{aligned}$$

Whence error of Tab. Geoc. Semidiam. = +3''.48.

Applying this as a correction to the semidiameter used in the reduction of the observations of Z.D. of Moon's U.L. we find tabular error of Moon:—

$$\begin{aligned} \text{In R.A.} &= +0''.54 \\ \text{In N.P.D.} &= +2''.54 \end{aligned}$$

As from altazimuth observations of the *bright* Moon the error of semidiameter in azimuth = $-0''.5$, the eclipse observations give for the sum of irradiations of Sun and Moon with the altazimuth 4''.0 for an object-glass of $3\frac{3}{4}$ -inches.

With the Great Equatoreal (aperture $12\frac{3}{4}$ -inches) the value appears to be about 0''.5.

The Solar Eclipse, Dec. 22, 1870. By the Rev. S. J. Perry.

(Communicated by W. H. H. Hudson, Esq.)

A mere glance at the published results of the late Eclipse Expeditions will be sufficient to convince any one, who is at all conversant with the subject, of the great advance that has just been made in our knowledge of solar physics. That so much should have been accomplished, when the obstacles to success